TITLE OF THE INVENTION

ELASTICALLY DEFORMABLE VALVE WITH AUTOMATIC CLOSURE FOR THE CONTROLLED DISPENSING OF FLUIDS FROM FLUID CONTAINERS

FILED OF THE INVENTION

The present invention relates to an automatically closing valve applicable to deformable containers for fluids, the valve being formed in one piece by moulding thermoplastic material of high elasticity and having a head or dome divided into several segments by cuts converging at the centre of said head to define flexible segments or appendices which flex outwards from the container when the container is squeezed manually, and which automatically assume their valve-closed rest position when the pressure within the container ceases.

BACKGROUND OF THE INVENTION

Valves of this type are well known and are widely used because of their low production cost and high operational reliability.

In general terms, these valves all comprise a central dome or wall extending from a cylindrical skirt or side wall having a profiled annular free end which is sealedly locked onto a connection bush or body fixed into a hole provided in a deformable container previously filled with the fluid to be dispensed, such as liquid soap, soap or various solutions for washing the hair, household detergents, liquid household products for cleaning and disinfecting, softening creams, creams for the human body etc.

Cuts are provided in the central dome or wall of the valve and pass through its entire thickness: the cuts are normally two in number and cross each other at the central point of the dome, to hence define four separate flexible segments the edges of which are in sealed mutual contact when the valve is at rest, but flex outwards (and hence withdraw from each other) when the fluid within the container is put under pressure by manual deformation of the container itself.

Two mutually contrasting requirements are present, namely

that the valve returns automatically into its rest position of sealed closure on termination of the dispensing stage, and that the valve is able to easily and gradually open (to dispense the fluid) when the container on which the valve is mounted is deformed or squeezed manually.

DESCRIPTION OF RELATED ART

DE-A-4403081 describes a valve, the dome (5) of which has a very large thickness, whereas the tubular skirt (6) which connects it to its profiled free end (3) is very thin. For dispensing to take place, the strong elastic resistance of the constituent material of the dome has to be overcome, this being necessarily of considerable thickness in order to form a seal when in the rest state. All this is aggravated by the fact that the dome diameter is very small and hence the four flexible segments defined by the four crossing cuts provided in it are very short. It follows that a large pressure has to be exerted manually on the container to open the valve, and that the valve opens suddenly (rather than gradually), to hence violently spurt the compressed fluid outwards.

US-A-5409144 describes a valve, the dome of which is similar to the aforesaid, but is connected to its free edge by a flexible tubular wall which under rest conditions maintains the dome withdrawn and displaced into the interior of the container on which it is applied, the said tubular wall flexing strongly about itself until it is expelled (together with the dome) to the outside of the container gradually as the fluid pressure increases. This inversion of the tubular wall about itself contributes to the opening or, vice versa, to the closure of the cuts provided in the dome of the valve, the structure of which is very complicated with more or less uncertain operation, even though again relying on the large thickness of the dome compared with the small thickness of the tubular wall.

EP-A-0885813 differs from the aforestated US patent essentially in that the valve dome is provided in an elastic wall of very small thickness, equal to that of the

tubular wall which connects it to the profiled fixing edge of the valve, the drawback of which is that the elastic forces of its constituent material are insufficient to ensure sealing under rest conditions (the valve thickness being very small both at its tubular wall and at its dome), to the extent that sealing can be achieved only by the use of a rigid cover which is kept pressed on the outer surface of the valve dome when at rest. Moreover, when the fluid is to be dispensed via the valve, the valve opens completely and immediately as soon as the fluid pressure overcomes the very weak resistance of the valve, so that it is practically impossible to control the quantity and speed of the fluid dispensed.

EP-B-1061001 and the corresponding US-A-6199725 describe a valve which provides excellent sealing under rest conditions and enables the valve to be opened gradually when a predetermined pressure is exceeded, this valve having however a very elongate and complex structure which makes it difficult to produce with automatic machines.

SUMMARY OF THE INVENTION

The main object of the present invention is to provide a valve as a single piece of elastically deformable thermoplastic material, which ensures sealed valve closure under rest conditions, but which in particular enables gradual valve opening to be obtained with easy control of the speed and quantity of fluid dispensed therethrough when the fluid is to be dispensed from the container to which the valve is applied.

This and further objects are attained by an automatically closing valve for the controlled dispensing of fluids from deformable containers, which is formed as a single piece of elastomeric material and comprises a tubular skirt, one end of which is profiled to present an edge engagable in a ring cap to be mounted at a discharge hole provided in each container, the other end of the tubular skirt being closed by a dome or transverse wall in which cuts are provided to define flexible appendices therein, the edges of which are

in mutual sealed contact in the closed valve, characterised in that when the valve is in its rest state, said dome is defined by curved surfaces re-entrant into the interior of the cavity in the tubular skirt which, at least in proximity to said dome, has an annular portion thereof of such a shape and thickness as to enable it to dilate and to flex elastically outwards when the dome passes from its form re-entrant into the skirt, to firstly a flat form and then to a form in which said appendices are flexed outwards, withdrawing from each other, under the thrust of the compressed fluid emerging from the container, said annular portion of the tubular skirt acting with elastic force on said dome to urge it towards its rest position curved in the interior of the tubular skirt and with said flexible appendices sealedly pressed against each other.

Preferably, said annular portion of the tubular skirt is of small axial extension at and in proximity to said dome or transverse wall, and again preferably the thickness of said dome or transverse wall is greater in proximity to the tubular skirt than in the central region of the dome.

BRIEF DESCRIPTION OF THE DRAWINGS

To further clarify the understanding of the structure and characteristics of the valve according to the invention, a preferred embodiment is described hereinafter by way of non-limiting example with reference to the accompanying drawings, in which:

Figure 1 is a side elevation of the valve;

Figure 2 is a cross-section through the valve on the line 2-2 of Figure 1;

Figure 3 is a plan view of the valve of Figure 1 from above;

Figures from 4 to 7 show the valve in cross-section, mounted on a ring cap applied to the neck of a plastic bottle, the figures showing the valve in its different successive stages of opening; and

Figure 8 is a plan view from above of the valve with ring cap in the position of Figure 7.

Reference will firstly be made to Figures from 1 to 3 from which it can be seen that the valve is formed as one piece (of elastically flexible material) and comprises a tubular skirt 1, 2, at one end of which there is provided a profiled edge 4 and the other end of which is closed by a dome or transverse wall 3 in which there are provided cuts 5 which mutually intersect to define four flexible appendices 6 (of substantially triangular shape in plan with their vertex in common at the centre of the dome, as can be seen in particular in Figure 3) the edges of which are in mutual sealed contact at the cuts 5 when the valve is at rest, i.e. closed.

It can be seen that the tubular portion 2 of the tubular skirt 1, 2 is thinner at and in proximity to the dome 3 than the tubular portion 1, its thickness and shape being such as to enable it to deform (as if "swelling") by elastically flexing outwards (Figures 6 and 7) when the fluid present in the valve cavity is put under pressure, as described hereinafter.

From Figures 2 and 4 it can be seen that under rest conditions, the dome 3 is defined by curved surfaces re-entrant into the interior of the cavity of the tubular skirt, the profiled edge 4 of which enables the valve to be securely mounted in a ring cap 7 (Figures from 4 to 8) which itself can be sealedly applied to the neck 8 (a short portion of which is shown in Figures from 4 to 7) of a deformable bottle or the like, the discharge hole of which is hence intercepted by the valve.

From those figures in which the valve is shown in section, it can also be seen that the thickness of the dome or transverse wall 3 is greater at the periphery than at the centre of the dome itself.

It will now be assumed that the valve is mounted on the ring cap 7, itself mounted on the neck 8 of a deformable bottle (or the like) containing a fluid (such as liquid soap, soap or solutions for hair treatment or washing, liquid products for household cleaning and disinfecting,

creams of various kinds, etc.), a small quantity of which is to be dispensed at a controlled rate when required.

Under the rest conditions shown in Figure 4 the valve is closed and the flexible appendices 6 are maintained pressed one against the other along the cuts 5 provided in the dome 3.

When the bottle is deformed, i.e. squeezed with one hand, the fluid contained therein is pressurized to cause the dome to rise upwards (Figure 5) until the appendices 6 are made to lift outwards, with simultaneous outward dilation (swelling) of the portion 2 of the tubular skirt, as shown in Figure 6. With continued squeezing of the bottle, the appendices 6 rotate outwards (Figure 7) to withdraw the sides of each appendix from those of the appendices 6 adjacent to it, to hence form a free hole in the shape of a four-pointed star (as can be seen from Figure 8) through which the fluid can be dispensed from the bottle through the valve.

When the manual deformation action exerted on the bottle ceases, the pressure of the fluid decreases within it and the portion 2 of the skirt acts elastically on the dome 1, to return it to its rest state by passing from the configuration of Figure 7 to that of Figures 6, 5 and 4 in that order.

It is important to note that, by virtue of the described structure, the valve opens smoothly and gradually, with consequent smooth and gradual commencement of fluid dispensing, rather than the "spurt" as happens with similar valves of known type which open suddenly and uncontrollably